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Construction of a low-level ^{14}C facility at the University of Arizona

Since its inception the 1950's, carbon-14 (or ^{14}C) dating has been the main workhorse for dating of archeological materials on every continent. Laboratories worldwide routinely provide reliable ^{14}C dates in the 0-40,000 year range to the archeological and geological community. However, geochronologists widely recognize that the reliability of the technique quickly degrades in samples older than about 40,000 years. The theoretical measurement limits on ^{14}C dating are more on the order of 65,000 years, but in practice reliable dates in the 40,000 to 65,000 year range have yet to be realized. The reason is simple but solutions are complex: the amount of "original" ^{14}C used for age estimation in very old samples (>40,000) is tiny, and is easily contaminated with ^{14}C introduced into the sample after burial and even in the laboratory extraction process. With NSF support, a team of geochronologists at the University of Arizona, spearheaded in the laboratory by post-doctoral fellow Jeff Pigati, has tackled these difficult contamination problems with construction of a new, "low-level" ^{14}C apparatus (see figures below). Recent tests of the new extraction line demonstrate that reliable dates should be obtainable on archeological charcoal over much of the current 40,000-65,000 year gap.

There are many potential applications of the new low-level ^{14}C system to long-standing questions in archaeology and anthropology. Among these is the debate among archaeologists on arrival times of anatomically modern human populations in Europe and across the Old World during the period ~30,000 to 60,000 years ago. Our facility is uniquely positioned to examine whether current reconstructions of these peopling events are chronologically sound or merely artifacts of contamination. In the end we expect our apparatus to serve as a prototype for other laboratories intent on providing reliable dates in the >40,000 year range to archeologists.



Figure 1a Extraction system



Figure 1b Graphite system